

Bull. Natn. Sci. Mus., Ser. A (Zool.), 2 (4), December 22, 1976

Occurrence of *Stygiotrechus* (Coleoptera, Trechinae) in the Island of Shikoku, Japan¹⁾

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The most unexpected event in the history of studies on the Japanese Trechinae was recently marked by Mr. Masaaki SATOU. It is the discovery of a *Stygiotrechus* in the Island of Shikoku!

Though small (18,780 km² in area), this island is very rich in the subterranean fauna, and has previously been known to harbour about forty species of anophthalmic trechines belonging to eight different genera (cf. UÉNO, 1975, p. 209). However, all but one of them have affinities either with the species occurring in central Kyushu or with those of the Kii Mountains; that is, they belong to the fauna characteristic of the Pacific side of Southwest Japan. The only exception is *Trechiamma satoui* of the Sanuki Hills, which is closely related to the species distributed in the central and eastern parts of the Chūgoku Hills in western Honshu (cf. UÉNO, 1975, pp. 204–207, 210–212). Apart from winged oculate forms, no representative of the *Trechoblemus* complex, whose members are primarily distributed on the Japan Sea side in West Japan, has ever been met with in any place of Shikoku. This has appeared different from the situation of the Kii Peninsula, where the genus-group is represented by both *Kurasawatrechus* and *Stygiotrechus* (cf. Fig. 5), and led to the conclusion that Shikoku was isolated longer than its neighbouring areas, as is suggested by geological evidences.

With the discovery of an endogeal species of *Stygiotrechus* belonging to the *Trechoblemus* complex, we have to reconsider the constitution of the trechine fauna of the Island of Shikoku. As will be shown in later pages, the newly found species is closely related to *S. ohtanii*, an endogeal form endemic to Mt. Kongō-zan in the Kii Peninsula. Both the trechines occur on the remnants of the ancient Sanuki-Izumi Range having stretched from east to west along the northern side of the Median Tectonic Zone, which is represented at present by the valleys of the Ki-no-kawa and the Yoshino-gawa Rivers. This seems to suggest that the common ancestor of the two species had once been widespread on the ancient range and became differentiated after the separation of its western part (Sanuki Hills) from the eastern (Izumi Hills). Though the former is included in Shikoku by the present topography, it is zoogeographically closer to Honshu than to the other mountainous areas of the island, at least eyeless subterranean forms are concerned.

1) This study is supported in part by the Grant-in-aid for Scientific Research from the Ministry of Education, No. 154258.

In the present paper, I am going to describe the new species under the name of *Stygiotrechus satoui* in commemoration of Mr. SATOU's new achievement. The abbreviations used are the same as those explained before (cf. UÉNO, 1969, p. 485).

Before going into details, I wish to express my hearty thanks to Messrs. Masaaki SATOU and Masataka YOSHIDA for kindly submitting their specimens at my disposal for study. I am also deeply indebted to Mr. Isamu HIURA for furnishing useful information on the paleogeography of the areas concerned.

Stygiotrechus satoui S. UÉNO, sp. nov.

(Figs. 1-4)

Length: 2.50-2.85 mm (from apical margin of clypeus to apices of elytra).

Closely allied to *S. ohtanii* S. UÉNO (1969, pp. 490, 491, fig. 5; 1973, p. 29) and accords with its description in basic characters, but the colour is evidently darker, the genae are more distinctly angulate, the prothorax is obviously larger, having broader base and less prominent hind angles, the elytra are ampler at the basal area and have salient shoulders, and the striae are deeper on the disk.

Body more parallel-sided than in *S. ohtanii*. Colour reddish brown to dark reddish brown, shiny, translucent when alive; palpi, apical half of antennae, ventral side of hind body, and legs yellowish brown; clypeus, labrum and scape also yellowish brown in some individuals.

Head relatively small, transverse, and gently convex on the dorsal side, which is sparsely covered with short pubescence; frontal furrows lightly impressed, becoming shallower behind though entire, moderately divergent anteriad, very widely and rather abruptly so posteriad, but not distinctly angulate at middle; frons and supraorbital areas feebly convex, vertex with a pair of suprafrontal setae; microsculpture isodiametric, coarse and almost granular except on vertex, where it consists of large polygonal meshes in fine lines; genae angulately convex just before neck constriction and gradually convergent anteriad, being covered with short pubescence; neck very wide, neck constriction distinct though not deep; labrum transverse, with the anterior margin slightly bituberculate at middle; mentum free, with a broad bifid tooth in apical emargination; antennae short, stout, submoniliform and gradually dilated towards apices, though being a little thinner than in *S. ohtanii*, reaching basal three-tenths to one-third of elytra in ♂, basal one-fourth to two-sevenths of elytra in ♀; antennal segment 2 nearly as long as segment 3 or 4, segments 8-10 each subovate and about 1.5 times as long as wide, terminal segment the largest.

Pronotum subquadrate, distinctly wider than head and a little wider than long, widest at about two-thirds from base, and equally and gently contracted in front and behind; PW/HW 1.30-1.38 (M 1.32), PW/PL 1.05-1.14 (M 1.11), PW/PA 1.23-1.31 (M 1.27), PW/PB 1.16-1.22 (M 1.18); sides feebly arcuate in front, either straight or very slightly sinuate behind, and distinctly indented in basal third; base always wider than apex, PA/PB 0.90-0.96 (M 0.93); hind angles either rectangular or obtusely denti-

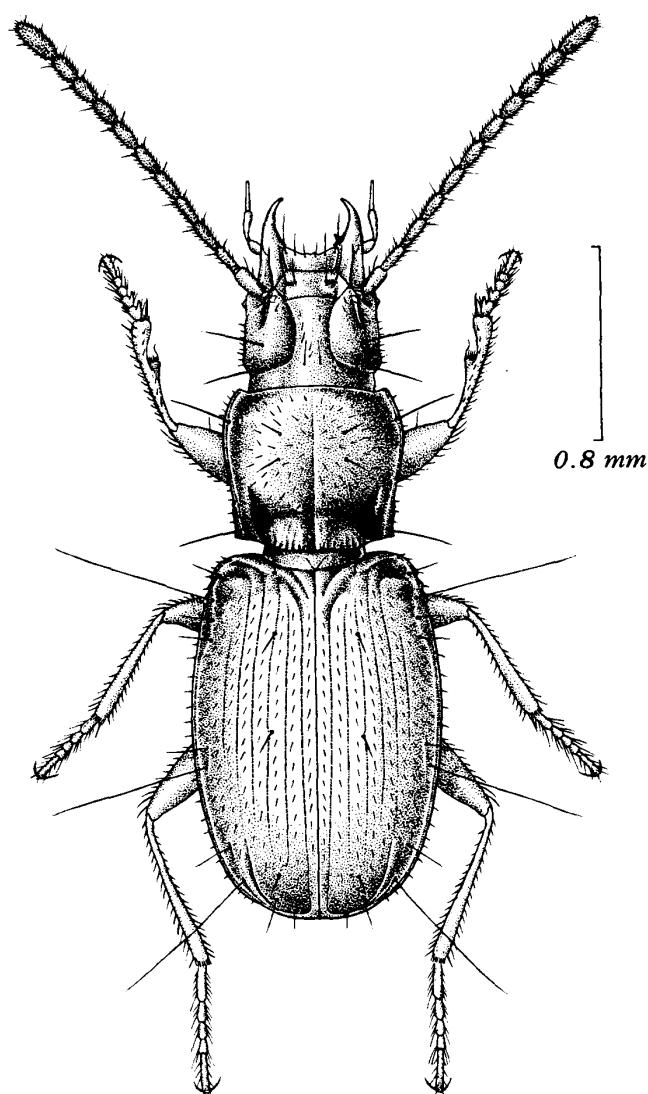


Fig. 1. *Stygiotrechus satoui* S. UÉNO, sp. nov., ♂, of Ôyashiki in the Sanuki Hills.

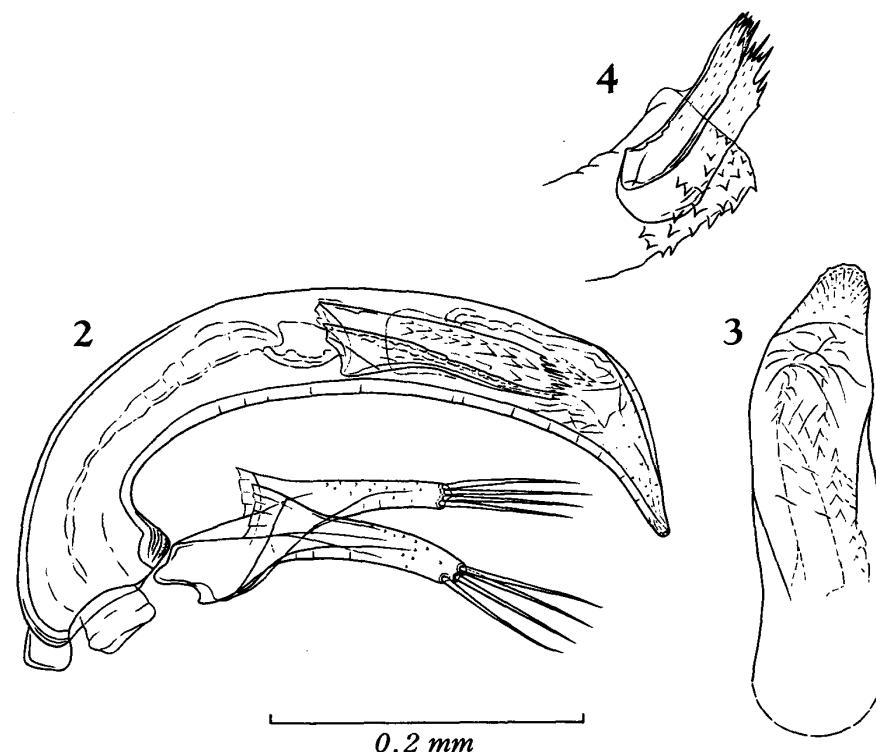
culate, not so sharply projecting as in *S. ohtanii*; median line deeply impressed and usually reaching base; basal transverse impression shallow though continuous, basal foveae fairly large and elongate; other pronotal features as in *S. ohtanii*.

Elytra oblong-ovate, convex, widest at about four-ninths from base, and only weakly contracted basad; EW/PW 1.29–1.36 (M 1.33), EL/EW 1.48–1.60 (M 1.55); basal area broad and ample; shoulders square, evidently more salient than in *S. ohtanii*, and more or less reflexed; humeral borders each provided with three or four (sometimes five, rarely two) distinct teeth, which are preceded by one to four (usually one or two) minute serrations and usually followed by an obtuse one; prehumeral borders perpendicular to the mid-line, though short; sides nearly straight behind shoulders, then very feebly arcuate to the level of the seventh pore of the marginal

umbilicate series, and widely, almost conjointly rounded at apices, though bearing a minute re-entrant angle at suture; preapical emargination very slight; striae impunctate, deeper on the disk than in *S. ohtanii* though becoming shallower towards apex and at side, stria 6 usually visible at middle, 7 either obsolete or fragmentary, 8 irregularly impressed behind middle; scutellar striole distinct though short; apical striole distinct, nearly straight in front and joining stria 5; intervals slightly convex near suture but flat at the side, each with an irregular row of short erect pubescence; apical carina distinct though obtuse; stria 3 with two setiferous dorsal pores at $1/5-1/4$ and $4/9-2/5$ from base respectively; other setiferous pores and microsculpture as in *S. ohtanii*.

Ventral surface and legs as in *S. ohtanii*, though the legs are a little slenderer than in the latter; in ♂, two proximal segments of each protarsus moderately dilated, inwardly denticulate at apices, and furnished beneath with adhesive appendages.

Male genital organ small and lightly sclerotized, resembling that of *S. pachys* in general appearance (cf. UÉNO, 1970, p. 609, fig. 3). Aedeagus two-sevenths as long as elytra, tubular, regularly arcuate and somewhat twisted, with the dorsal side semi-circularly rounded in profile; basal part small, curved ventrad and with a small sagittal aileron; basal orifice with its sides only slightly emarginate; viewed laterally, apical part curved ventrad, subacuminate and blunt at the extremity; viewed dorsally, apical



Figs. 2-4. *Stygiotrechus satoui* S. UÉNO, sp. nov., of Ōyashiki in the Sanuki Hills. — 2. Male genitalia, left lateral view. — 3. Apical part of aedeagus, dorsal view. — 4. Everted inner sac, showing copulatory piece.

lobe broad, inclined to the left and widely rounded at the extremity; ventral side evenly emarginate at middle in profile. Inner sac scaly near apical orifice though the scales are only poorly sclerotized, and armed with a large spatulate copulatory piece, which is irregularly spinose at apex. Styles fairly slender, left style a little larger and longer than the right, each bearing four setae at apex.

Type-series. Holotype: ♂, allotype: ♀ (6-VI-1976, M. SATOU leg.). Paratypes: 2 ♂♂, 1 ♀ (6-VI-1976, M. SATOU leg.); 5 ♂♂, 1 ♀ (12-VI-1976, M. SATOU leg.); 1 ♂, 2 ♀♀ (13-VI-1976, M. YOSHIDA leg.); 1 ♂, 3 ♀♀ (16-VI-1976, M. SATOU leg.). All deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

Type-locality. Ôyashiki, 490–550 m alt., in Shionoé-chô, at the central part of the Sanuki Hills, in Kagawa Prefecture of northeastern Shikoku, Japan.

Notes. Ôyashiki, the type-locality of this new species, is situated at the western side of Mt. Ohtaki-san and is about 1.3 km distant to the east from Besshi, where the first specimens of *Trechiamma satoui* were obtained (cf. UÉNO, 1975, p. 207). The habitat of the beetle was found in a small gully on the right side of the Kodé-gawa River. The gully was shaded with a dense grove and was dim even in the daytime. Its bottom was thickly covered with mud and stones, among which dwelled the present trechine. Mr. SATOU told me that many of his specimens were found out with the aid of a cap-lamp, as the beetle is very small and its habitat is unusually dark. Three specimens (2 ♂♂, 1 ♀) of *Trechiamma satoui* were also obtained at the same place by Messrs. SATOU and YOSHIDA. They were proved identical with the Daisen-zan specimens by a careful comparative study of the male genitalia.

Discussion

As was noticed before, *Stygiotrechus satoui* has a definite affinity to *S. ohtanii* of Mt. Kongô-zan. This means that the common ancestor of the two species must have dispersed along the ancient Sanuki-Izumi Range, which existed in the Plio-Pleistocene. Unfortunately, no agreement of geologists' views seems to have been reached on the paleotopography of the areas concerned. Generally accepted opinion seems to be that the subsidence of the Kii Channel (or the separation of the western part of the ancient range from the eastern) took place at the beginning of the Pleistocene (e.g., ITIHARA, 1966, p. 16; YOKOYAMA, 1969, pp. 76, 79) or still earlier (e.g., ISHIDA, 1970, p. 106), and that the upheaval of the Sanuki and the Izumi Hills occurred early in the Middle Pleistocene (e.g., ITIHARA, *loc. cit.*). If such was really the case, we have to conclude either that the two *Stygiotrechus* have survived on the hills since the Pliocene, or that their dispersal was accomplished at a later period across the Kii Channel. To accept the former view, the two species are too closely similar to each other; they would have become differentiated to a much greater extent during such a long time as the whole Quaternary. On the other hand, it is not easy to elucidate the transmarine dispersal of the ancestral trechine, since it should have been accomplished across a strong current. It is also difficult to determine from which direction the trechine

extended its distribution.

Dealing with the Shikoku species of the genus *Trechiamia*, I (1975, pp. 210–211) came to the conclusion that *T. satoui*, which coexists with the present species, must have reached the Sanuki Hills from somewhere in the Chūgoku District across the Inland Sea of Seto-naikai, most probably through the agency of floods of large rivers. This can be inferred without difficulty, since members of that genus are usually long-legged and agile, and are apt to be carried by waters. However, the same route of dispersal may not have been followed by *Stygiotrechus*, whose members are usually

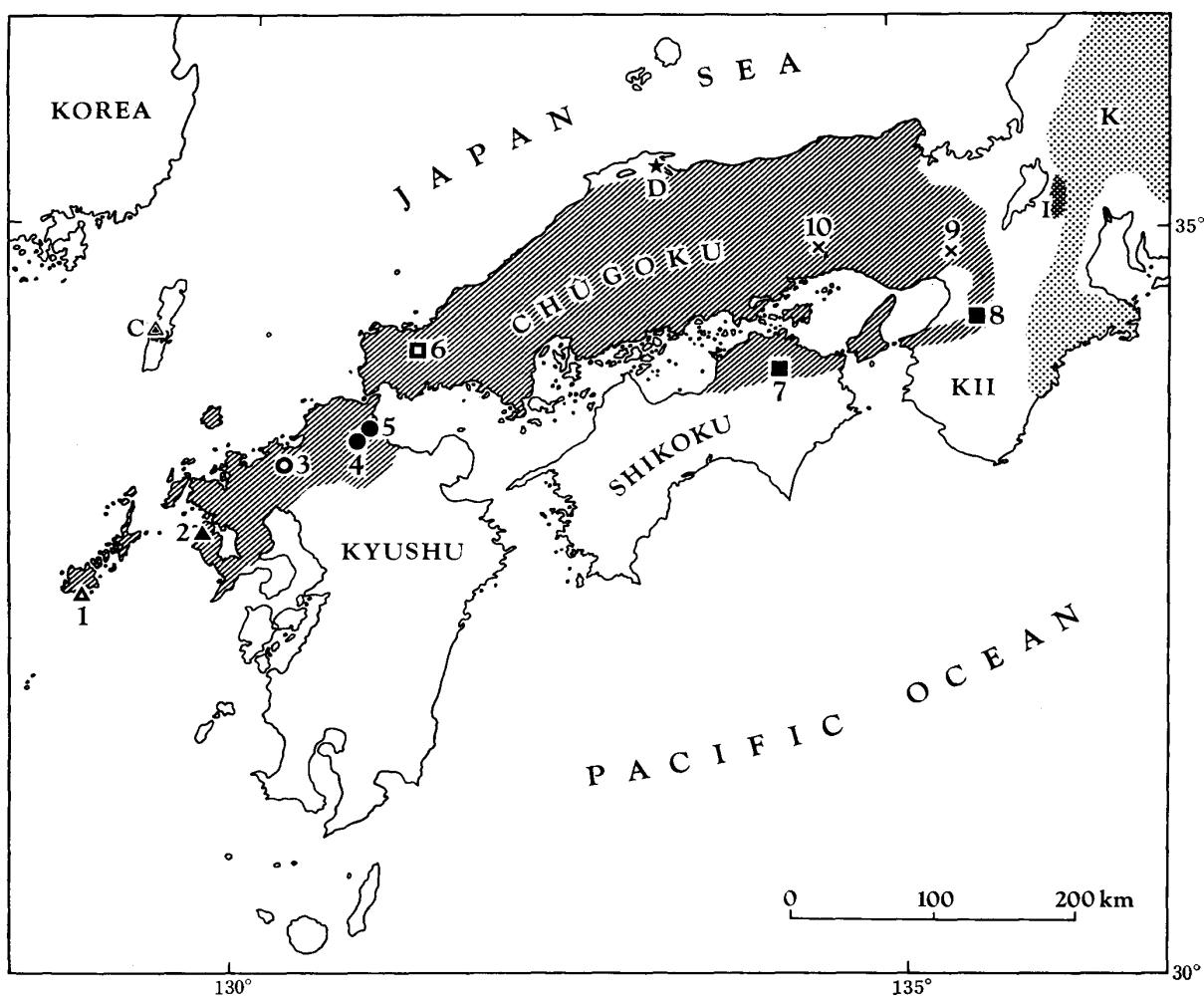


Fig. 5. Map showing the distribution of *Stygiotrechus* and its relatives in Southwest Japan. Diagonal hatching shows the probable range of distribution of *Stygiotrechus*. Difference of symbols indicates that of species-groups and/or genera. Compare this figure with fig. 14 in my previous paper (UÉNO, 1969, p. 512). — 1, *Stygiotrechus pachys* S. UÉNO and *Gobolemus ii* S. UÉNO; 2, *S. kubotai* S. UÉNO; 3, *S. esakii* S. UÉNO; 4, *S. miyoshiorum* S. UÉNO; 5, *S. unidentatus* S. UÉNO; 6, *S. parvulus* S. UÉNO; 7, *S. satoui* S. UÉNO, sp. nov.; 8, *S. ohtanii* S. UÉNO; 9, *S. morimotoi* S. UÉNO; 10, *S. sp.* (cf. *morimotoi* S. UÉNO). C, *Coreoblemus venustus* S. UÉNO; D, *Daiconotrechus iwatai* (S. UÉNO); I, known range of *Ishidatrechus*; K, southwestern tip of the distributional range of *Kurasawatrechus*.

short-legged and rather sluggish, and have never been met with in the debris of inundation. Their habitats are much restricted as compared with those of *Trechiamia*, and their differentiation is more intensive than that of the latter. As shown in Fig. 5, the eastern part of the Chûgoku Hills is occupied by *Stygiotrechus morimotoi*, which forms a species-group decisively different from that of *S. ohtanii*. This fact further denies the possibility that *S. ohtanii* and *S. satoui* have been separately derived from the mother stock that existed in the eastern part of the Chûgoku Hills. In all probability, the two species have become differentiated from an ancestral form, which was isolated in the ancient hills south of the ancient inland sea called Second Seto-naikai.

Two conjectures can be framed for the derivation of the ancestral trechine; one is that it first immigrated to the Kongô-Izumi Hills from somewhere in the eastern part of the Chûgoku Hills, became differentiated to such an extent as to form a species-group of its own, and later dispersed westwards into the Sanuki Hills; the alternative is that it reached the Sanuki Hills first, possibly from somewhere in western Chûgoku, and then immigrated to the Izumi Hills across the Kii Channel. The second assumption is supported by the fact that the group of *S. ohtanii* is taxonomically closer to *S. parvulus* of the Akiyoshi limestone area in western Chûgoku (No. 6 in Fig. 5) than to *S. morimotoi* of the eastern part of the Chûgoku Hills (Nos. 9 and 10 in Fig. 5), but the eastward dispersal from the Sanukis to the Izumis appears to be more difficult than its reverse. If we take this view, we had better look for a possibility of its dispersal on land, perhaps in certain glacial period of the late Pleistocene. The first assumption appears plausible considering that the Kongô-Izumi Hills have existed since the late Pliocene and that the paleocurrent at the northern side of the Izumi Hills was directed west, or towards the Sanukis, in the early Pleistocene. However, our knowledge is still insufficient regarding the paleogeography in the late Pleistocene, so that we have difficulties in reconstructing reliable route of dispersal of the ancestral trechine. In my present view, it is highly probable that the speciation of the two species belonging to the group of *S. ohtanii* took place in rather a recent period, perhaps in the late Pleistocene, when the immigration of their ancestor was somehow effected from one side of the Kii Channel to the other.

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